Usability Engineering:
A Critical Process in HSI[©]

Deborah Hix, Ph.D.

hix@vt.edu
540/231-6199

NUWC UHSI Symposium
3 - 5 May 2004

Virginia Polytechnic Institute & State University
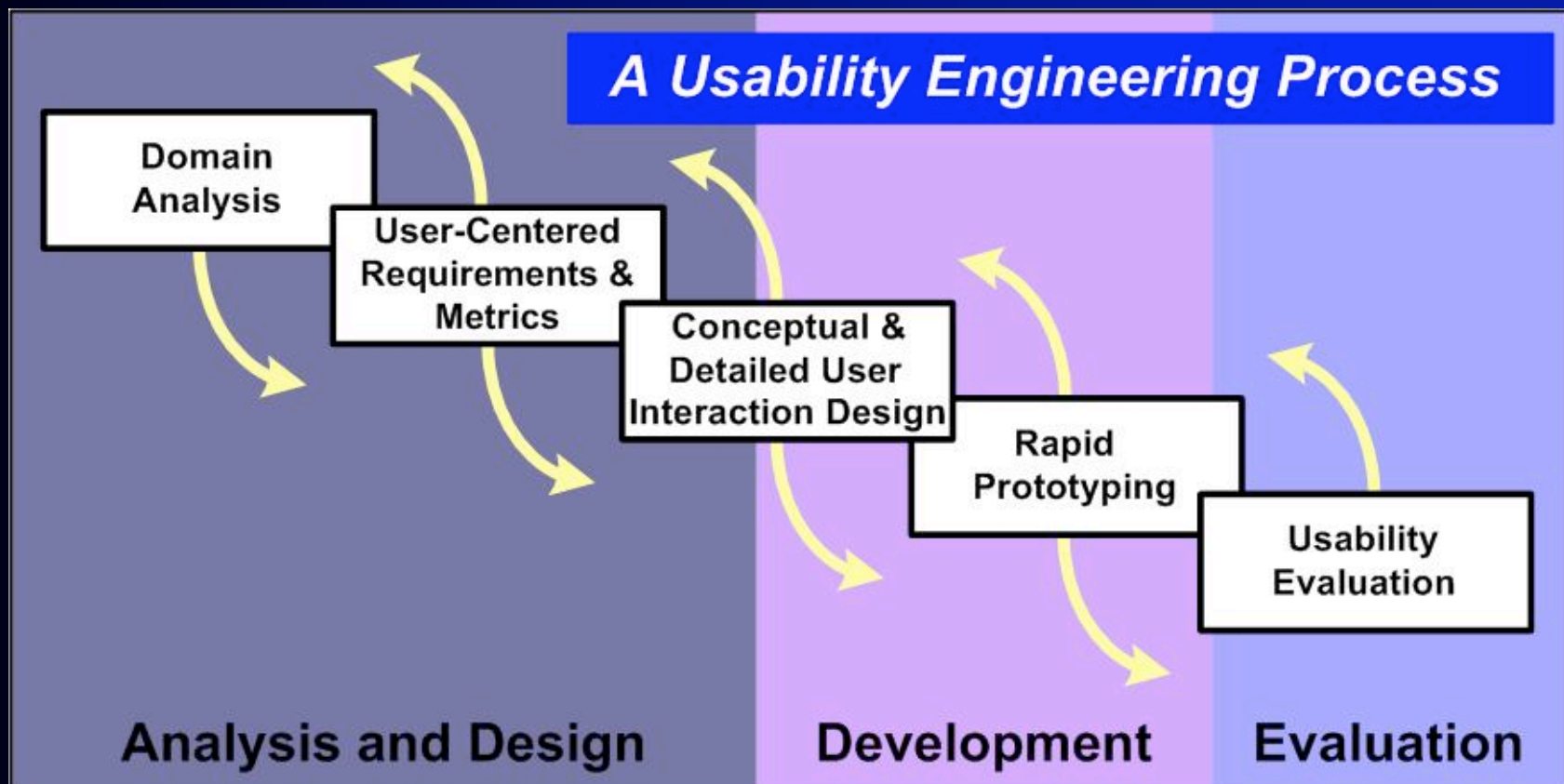**Blacksburg, VA**

Overview

- **What is Usability / Usability Engineering?**

- **Usability Engineering Activities (with exemplar projects)**

- **Cost Justifying Usability Engineering and Criticality of Usability Engineering in HSI**

What is Usability?

- **A characteristic of an interactive system that indicates**
  - How easy to use and
  - How useful that system is
- **Usability is related to measurable factors, such as**
  - User task time
  - User errors
  - User satisfaction
- **Note that these factors are *quantifiable*!**

What is Usability Engineering?

- **A successful, iterative, cost-effective, user-centered development process that ensures a high level of effectiveness, efficiency, and safety in a complex interactive system**

A Usability Engineering Process

Domain Analysis

User-Centered Requirements & Metrics

Conceptual & Detailed User Interaction Design

Rapid Prototyping

Usability Evaluation

Analysis and Design | Development | Evaluation

What is Usability Engineering?

BASF Corporation

"We don't make a lot of the products you buy. We make a lot of the products you buy better.®"
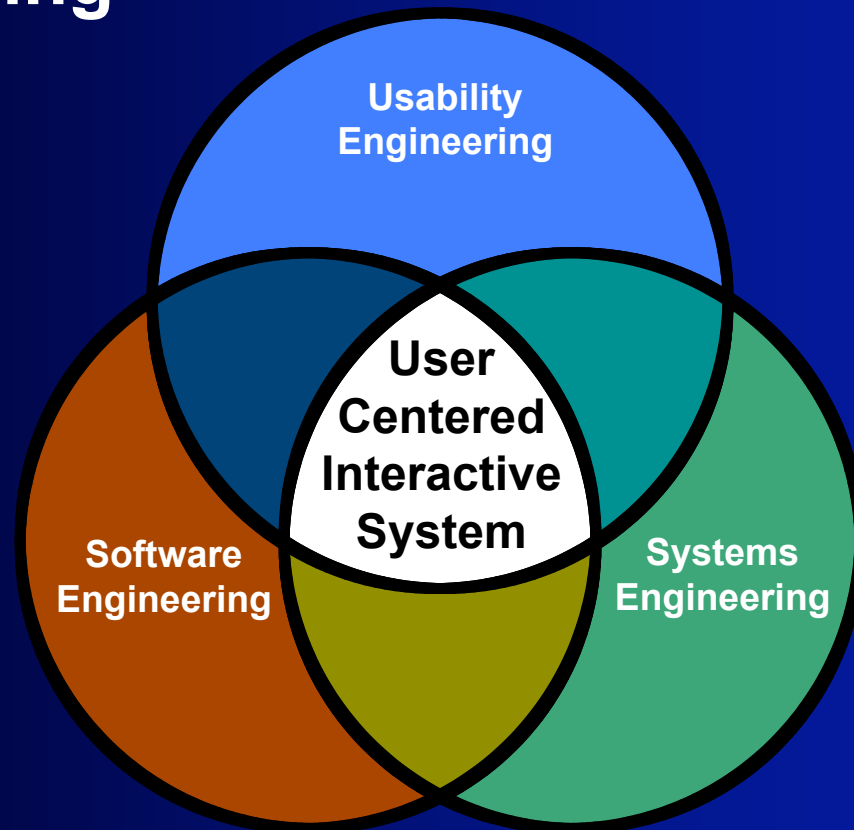
What is Usability Engineering?

"We don't make a lot of the products you buy. We make a lot of the products you buy better.®"

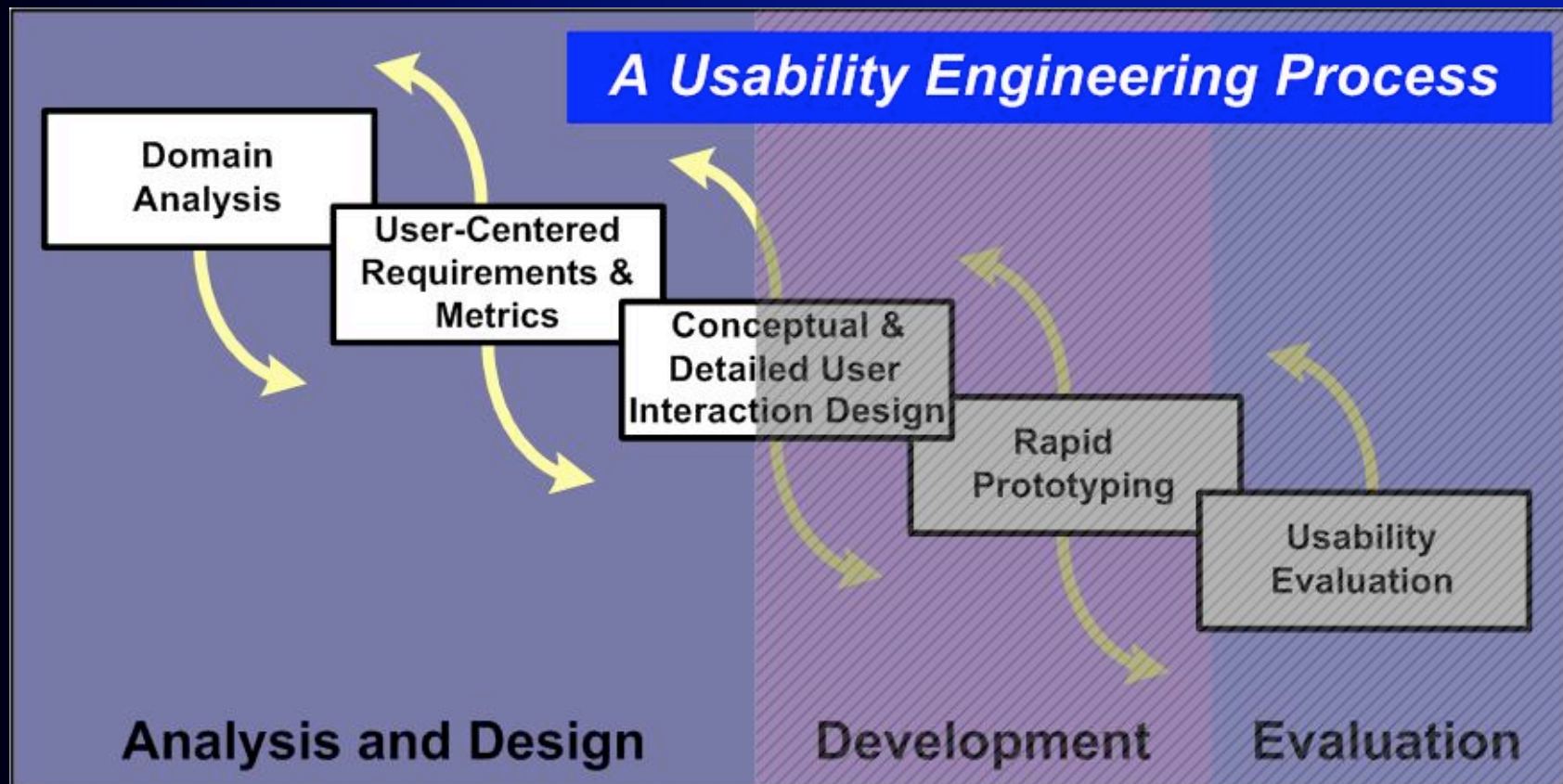**"We don't make the products. We make the products better."**

Usability Engineering

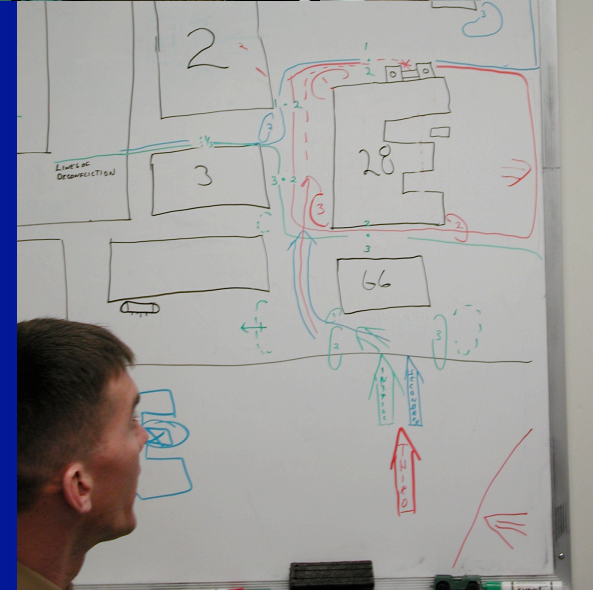- **HSI: Creating a complex interactive system requires more than systems and software engineering**

Analysis and Design

- **Usage domain / context, user classes, user tasks**
- **Usability metrics**

Domain Analysis

- **Working with subject matter experts, define usage context, user classes, user tasks**

- **Provides a strong basis for subsequent usability metrics and evaluation**

Example of Domain Analysis:
Battlefield Augmented Reality System (BARS)

- **BARS domain analysis produced:**
  - User classes for mobile warfare in urban terrain
 - Urban task scenarios supporting two BARS user classes

User-Centered Metrics

- **Critical for establishing quantifiable goals and benchmarks / baselines for user task performance during usability evaluation**
- **Most common: user task times and user errors**
- **Simple exemplar user performance metrics:**
  - 90% of users will be able to perform task X in 2 minutes or less with no training
  - 95% of users will be able to perform task Y with no more than 1 error after 10 minutes of usage
  - Currently 5 minutes to perform task Z the first time; reduce to 4 minutes

Usability Engineering Activities

- **Usability evaluation** to determine usability problems and user performance difficulties
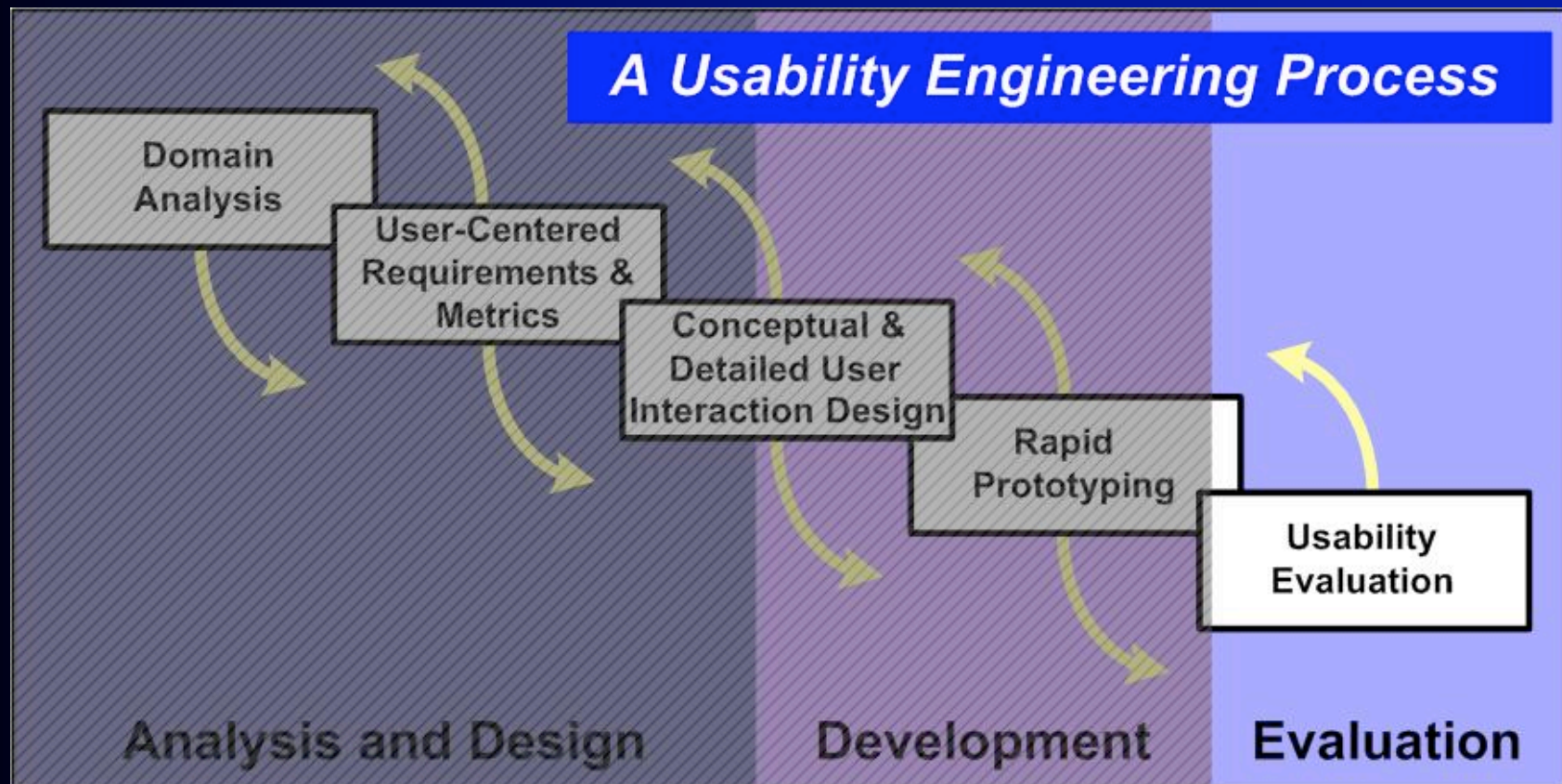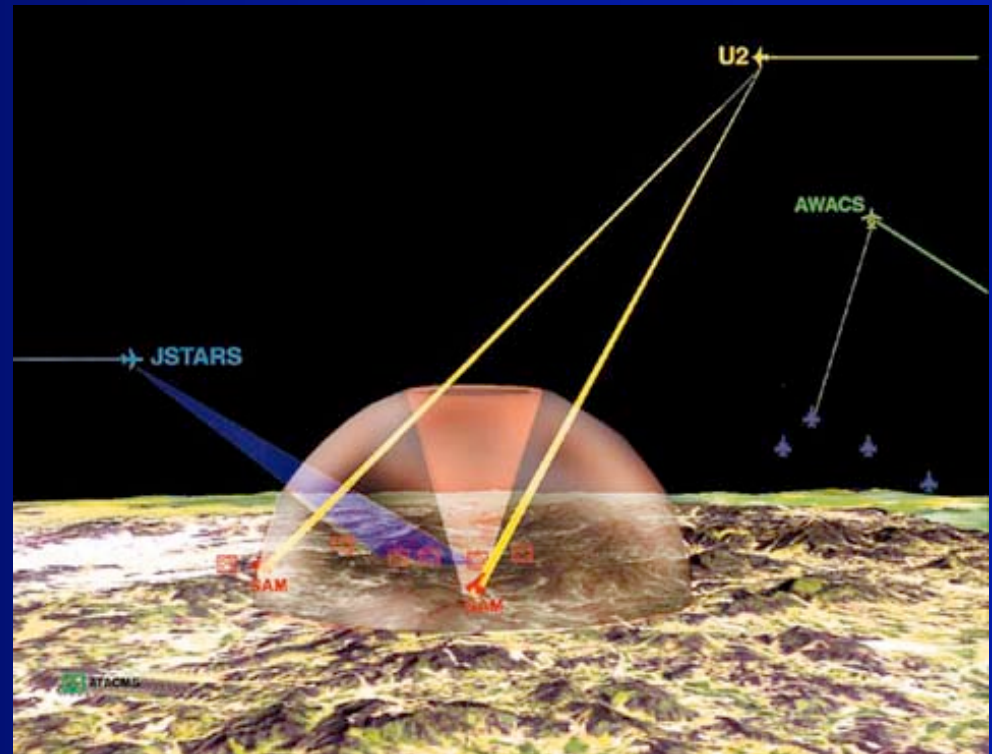
Expert Usability Evaluation

- **Assessment by user interaction design experts, very early during development**
- **Goal is to improve the usability of an evolving interaction design**
- **One or more experts critique evolving design**
  - Look for design guideline violations
  - Give suggestions for redesign
- **(Arguably) the most cost-effective usability evaluation method**

Example of Expert Usability Evaluation:
C^2 System for Joint Forces Watch Officer

- **Novel user interaction devices and visualizations**

- **Application successfully integrated into several FBEs**

Formative Usability Evaluation

- **Assessment with carefully chosen representative users**

- **Goal is to iteratively measure and improve usability**

- **Users perform task scenarios in usability lab and / or realistic setting**

  – Evaluators collect both *quantitative* and *qualitative* data

  – Evaluators produce redesign suggestions

Example of Formative Usability Evaluation:
BARS

- **Users performed approximately 85% of tasks correctly and efficiently with less than 10 minutes of training using BARS**

# Another Formative Usability Evaluation Example: Nomad™

- **Augmented reality display hardware targeted for transition to hostile threat detection system currently fielded in Afghanistan**

Sequential Usability Evaluation

- **Cost-effective** approach
  - Postpones expensive types of evaluations
  - Improves user interaction design along the way

- **Adaptable** approach
  - Allows individualizing of evaluation methods for specific project / product
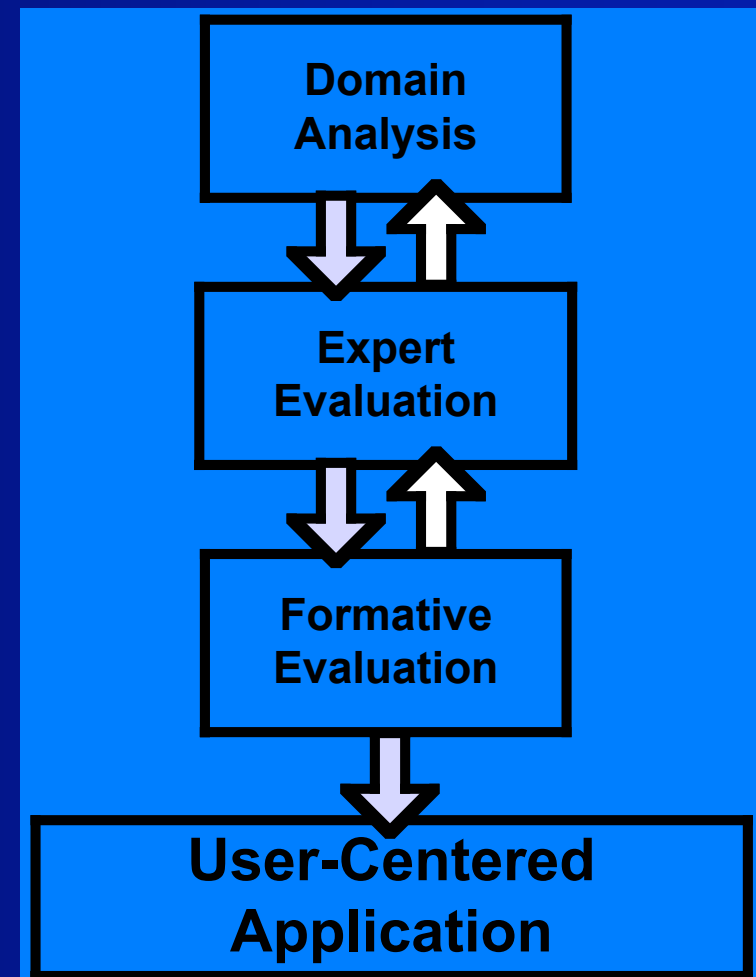
Cost Justification
of Usability Engineering

- *Resources needed for usability engineering: Minimum of 15% of total development effort*

- Q: Can we afford to include usability engineering in HSI processes?

- A: **Usability engineering does not add overall costs**
  - Usability saves on many other costs over total life cycle:
    - Costs of hardware and software vs. costs of "personware"
    - Costs of development vs. costs of operation

Cost Justification
of Usability Engineering

- **Usage savings can include costs of:**
  - User training
  - Operational productivity (reduced manning)
  - User errors (increased safety)
  - Documentation / On-line help
  - Database corruption
  - Help desk and user support operations
  - Employee dissatisfaction

- **Point: *Not more resources* to ensure usability, but *different resources* with different distribution during product's total life cycle**

Cost Justification: A Simple Example

- **Large distributed system for government agency**
- **From usability engineering, saved per year**
  = 75,000 users * 20 transactions/user-day * .5 min/trans * 230 days/yr * $25/hr * 1hr/60min

  = $71,875,000.00
- **Other measurable savings: user training, help desk. documentation**
- **Other less tangible savings: user errors, user satisfaction**
- **Regardless of what usability engineering costs were for this product, payback is enormous**

Why Usability Engineering / HSI is Critical to Transition of Complex Systems

- **Complex interactive systems transition all the time**

- **Usability engineering**
  - ensures that end-users' goals and needs are supported
  - can save development and operational costs
  - can improve user effectiveness, efficiency, and safety
  - can lead to reduced manning, reduced training, reduced human error, and increased productivity

Usability engineering as critical process in HSI ensures transition of *usable* Naval systems

"We don't make the (Navy) products.
We make the (Navy) products better."